Carbon Footprint of the University of Maryland, College Park: 2009 Inventory Update
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PREFACE

This report is the 2009 update to the *Carbon Footprint of the University of Maryland, College Park: An Inventory of Greenhouse Gas Emissions, 2002-2008* and includes data for Calendar Year (CY) 2009. The American College and University Presidents’ Climate Commitment (Presidents’ Climate Commitment, or the Commitment), to which the University of Maryland is a charter signatory, requires that participating institutions conduct biennial greenhouse gas inventories. The 2009 inventory was conducted on a calendar year basis to harmonize with other state and federal reporting requirements and will be conducted on a calendar year basis going forward.

ACKNOWLEDGEMENTS

The authors would like to thank Vice President for Administrative Affairs, Dr. Ann Wylie, for her financial support for the report and her ongoing leadership on climate action and campus sustainability. As with prior inventories, the Office of Sustainability has again provided essential support and consultation throughout the project. The data in this report were provided by more than 20 campus data holders. The authors appreciate their contributions and on-going partnership in measuring and reporting the campus carbon footprint.

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- **Frank Allnutt**, Director, Research & Education Centers, College of Agriculture & Natural Resources
- **Karen Breen**, Director, Business Services
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- **Ann Geronimo**, Director, Research Development
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- **George Long**, Manager, Golf Course Grounds
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1 [http://www.cier.umd.edu/campus_climate_action.htm](http://www.cier.umd.edu/campus_climate_action.htm)
EXECUTIVE SUMMARY

This report is an update of greenhouse gas emissions for the University of Maryland, College Park (UM, the University) for Calendar Year (CY) 2009. It measures progress against the campus baseline, Fiscal Year (FY) 2005. This inventory is part of the University’s participation in the American College and University Presidents’ Climate Commitment (Presidents’ Climate Commitment, or the Commitment) and will be submitted to Commitment organizers by September 15, 2010.

Background

In 2007, University of Maryland President Dan Mote signed the Presidents’ Climate Commitment, putting the institution on a path towards carbon neutrality. Carbon neutrality is defined as reducing greenhouse gas emissions as much as possible and offsetting any remaining emissions so that net emissions to the atmosphere are zero. In September 2009, the University submitted a Climate Action Plan to Commitment organizers.

This update follows the methodology used in prior inventories. The College Park campus and its larger satellite programs (Maryland Fire and Rescue Institute and the Maryland Agricultural Experiment Station farms) remain the scope of the inventory. Together, they comprise 398 buildings representing 13.4 million square feet of building space. The scope includes emissions associated with natural gas and electricity consumption, commuting, air travel, campus transportation, agricultural releases, solid waste management, and fugitive refrigerant releases. A standardized greenhouse gas calculator (Campus Carbon Calculator version 6.4, Clean Air-Cool Planet) was used. Full details on the methodology can be found in the 2002-2008 inventory and report at http://www.cier.umd.edu/campus_climate_action.htm.

Findings

- **Total GHG Emissions Decreased** – In CY 2009, the University’s carbon footprint was 284,951 \(^2\) metric tons of carbon dioxide equivalent (MT-CO\(_2\)e), an 8.5 percent reduction from FY 2008 emissions and a 10.5 percent reduction over the FY 2005 baseline. A small percentage of the reductions are associated with changes to better estimate commuter emissions. Emissions would equal 290,933 MT-CO\(_2\)e (a 6.6% reduction from FY 2008 and 8.7% reduction from FY 2005) without these accounting improvements. The University Climate Action Plan set a goal of a 15 percent reduction below 2005 levels by 2012.
- **Per Capita and Per Area Emissions Decreased** – Despite slight campus growth, per capita GHG emissions (MT-CO\(_2\)e per campus community member) and emissions per area (MT-CO\(_2\)e per square foot of total building space) decreased by 12.2 and 9.0 percent, respectively, compared to FY 2008.
- **A Number of Emission Sources Saw Significant Decreases** – Double digit reductions over FY 2008 levels were observed for purchased electricity, refrigeration, and solid waste.

\(^2\) 2009 emissions were equivalent to the GHG emissions of 48,461 cars. (Assuming a car traveled 15,000 miles/year * 0.045 gallons/mile * 0.00871MT-CO\(_2\)e/gallon= 5.88 MT-CO\(_2\)e/year).
Table E.S.1 Comparison of GHG emissions by source for years 2008 and 2009.

<table>
<thead>
<tr>
<th>Source</th>
<th>FY 2008 Emissions (MT-CO(_2)e)</th>
<th>CY 2009 Emissions (MT-CO(_2)e)</th>
<th>Change from previous year (MT-CO(_2)e)</th>
<th>% Change from previous year</th>
</tr>
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<tbody>
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<td>*</td>
</tr>
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<td>4,487</td>
<td>-111</td>
<td>-2.4%</td>
</tr>
<tr>
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<td>2,218</td>
<td>-78</td>
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<td>Stationary Sources</td>
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<td>5,275</td>
<td>236</td>
<td>4.7%</td>
</tr>
<tr>
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<td>4,005</td>
<td>2,550</td>
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<tr>
<td><strong>TOTALS</strong></td>
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<td><strong>284,951</strong></td>
<td><strong>-26,394</strong></td>
<td><strong>-</strong></td>
</tr>
</tbody>
</table>

*Prior to 2009, the number of commuter parking permits was overestimated because of the way in which data were available. A new methodology adopted for the CY 2009 inventory better estimates the number of full time equivalent (FTE) commuters. As this change affects the transportation baseline (FY 2008), much of the commuting reduction in CY 2009 is due to this accounting change, and therefore may not reflect an actual reduction in emissions.

Campus GHG emissions associated with the primarily natural gas-fired combined heat and power (CHP) plant and boilers (referred to as the On-Campus Physical Plant - used for electricity, heating and cooling), purchased electricity, and transportation accounted for 96 percent of total emissions (Figure E.S.2). The remaining 4 percent were produced by stationary sources (for cooking and emergency power generation), refrigerant releases, agricultural
activities (e.g., animal agriculture and nitrogen fertilizer application), and solid waste management. Figure E.S.3 shows each source’s contribution to CY 2009 GHG emissions.

![Diagram](image1.png)

**Figure E.S.2** Contribution of major sources to CY 2009 GHG emissions.

![Diagram](image2.png)

**Figure E.S.3** Breakdown of CY 2009 emissions by source.

**Discussion of CY 2009 Reductions**

Emissions in 2009 were lower in virtually all cases but there was variance in the degree to which the University had direct control over the reductions. Several of the larger reductions are discussed below.

- **Purchased Electricity** – Energy efficiency and conservation measures – the Energy Performance Contract with Johnson Controls, lighting retrofits, Tawes SCUB, and SCUB3 – reduced emissions 4,964 MT-CO₂e. The remaining reduction balance of 4,311 MT-CO₂e may
be attributed to more efficient operation of the CHP as well as milder summer temperatures.

- **Student commuting** – Newly obtained data show that the average fuel economy of student commuter vehicles was nearly 2 miles per gallon higher (24 mpg) than the previous estimate (22 mpg), resulting in a 1,890 MT-CO$_2$e reduction. Students also commuted a shorter average distance, resulting in a 671 MT-CO$_2$e reduction. The remainder of the reduction (2,280 MT-CO$_2$e) is due to a change in accounting practices.
- **Refrigeration** – Reductions are attributed to fewer releases associated with decommissioning and maintaining older units.
- **Solid waste** – The waste disposal process changed from landfilling more than 80 percent of solid waste without methane recovery to landfilling more than 85 percent with methane recovery and 15 percent with both recovery and electricity generation. The campus waste diversion rate also increased from 45.8 percent in 2008 to 57.4 percent in 2009.

**For Future Inventories**

- Collection of data about faculty and staff vehicles – make, model, year – would make the faculty and staff commuting emissions calculation more accurate. This information was collected from student commuters in 2009, which yielded overall campus emissions that were lower by 1,890 MT-CO$_2$e.
- Better information about commuting behavior, particularly frequency of trips to campus and use of alternative modes of transport would strengthen the inventory and provide information that could be used to improve green commuting options.
- Better capture of local addresses for students would ensure that commuting emissions are not misstated. As these data are self-reported as part of the commuter parking permit registration process, there appears to be no simple solution for improving data accuracy.
- The inventory did not include an estimate of GHG emissions associated with the consumption of materials and supplies (e.g., paper, food, bottled water). However, future inventories may include this category of carbon emissions so that mitigation efforts directed at modifying campus purchasing protocols can be evaluated and monitored.
- It will be important to ensure a consistent fuel mix is used to calculate purchased electricity for all University System of Maryland institutions as all 12 procure their purchased electricity through the same contract.
CAMPUS GHG EMISSIONS

CAMPUS OVERVIEW

During 2009, there were 34,437 full-time equivalent (FTE) students, 3,991 faculty, and 5,129 staff at the University for a total campus population of 43,557 people. The campus population has increased between FY 2005 and CY 2009 at an average 1.25 percent per annum (Figure 1).

The University of Maryland main campus occupies 1,250 acres of land in Prince George’s County with 264 buildings that include classrooms and laboratories, as well as residence halls, dining facilities, libraries, offices buildings, athletic facilities, and performance centers. The inventory also includes the Maryland Fire and Rescue Institute (MFRI) and the Maryland Agricultural Experiment Station (MAES) managed by the College of Agriculture and Natural Resources, which occupies an additional 1,300 acres of land throughout the State. In 2009, the University’s building space, including its satellite programs, occupied 398 buildings totaling 13.4 million square feet. Since 2005, square footage growth has been flat with an average annual growth rate of just 0.3 percent. (Figure 2). Additions in 2009 included Tyser Tower (61,457 sq ft.) and other, smaller buildings.
EMISSION TRENDS

In CY 2009, the University’s total GHG emissions were 284,951$^3$ MT-CO$_2$e, 26,394 MT-CO$_2$e less than FY 2008. As in previous years, the majority of the emissions came from on-campus energy use (co-generated electricity, steam, and purchased electricity) and transportation.

Figure 3 shows the University’s total emissions in metric tons of carbon dioxide equivalents (MT-CO$_2$e) from FY 2005-2008 and CY 2009. Emissions decreased from 318,527 MT-CO$_2$e in 2005 to 284,951 MT-CO$_2$e in 2009, a decrease of 10.5 percent. A small percentage of the reductions came from improvements in accounting for commuter emissions. Without these changes, emissions would equal 290,933 MT-CO$_2$e (a 6.6% reduction from FY 2008 and 8.7% reduction from FY 2005).

Table 2 shows heating and cooling degree days for FY 2005-2008 and CY 2009. A degree-day is a measure of how outside temperature differs from a standard of 65 degrees Fahrenheit. Degree-days indicate how much energy is needed for space heating or cooling. The more extreme the temperature, the higher the degree-day number.

**Table 2.** Heating Degree Days (HDD) and Cooling Degree Days (CDD) for the State of Maryland & DC$^4$.

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Heating Degree Days</td>
<td>4,766</td>
<td>4,345</td>
<td>4,553</td>
<td>4,456</td>
<td>4,851</td>
</tr>
<tr>
<td>Cooling Degree Days</td>
<td>1,010</td>
<td>1,282</td>
<td>1,221</td>
<td>1,250</td>
<td>944</td>
</tr>
</tbody>
</table>

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$^3$2009 emissions were equivalent to the GHG emissions of 48,461 cars. (Assuming a car traveled 15,000 miles/year * 0.045 gallons/mile * 0.00871 MT-CO$_2$e/gallon= 5.88 MT-CO$_2$e/year).

The University’s total energy use (including transportation) peaked at 4.86 trillion Btu’s in 2005 (Table 3) then slightly decreased between 2006 and 2008. These reductions can be attributed in part to operation of the combined heat and power plant (CHP) and ongoing energy conservation measures implemented by the campus. In 2009, implementation of an Energy Performance Contract in nine campus buildings, continuation of energy conservation measures, as well as milder summer temperatures contributed to the overall reductions. In addition, higher student vehicle fuel economy and shorter commuting distances also led to lower total energy use in 2009. Other reductions in 2009 included emissions associated with solid waste disposal and refrigerant releases. See the ‘GHG Emissions by Source’ section for specific details.

Table 3. Trends in energy use, GHG emissions, and GHG emissions intensity indices.

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td><strong>Energy use &amp; emissions</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total energy use (trillion Btu)</td>
<td>4.86</td>
<td>4.78</td>
<td>4.75</td>
<td>4.72</td>
<td>4.31</td>
</tr>
<tr>
<td>Change from previous year</td>
<td>1.5%</td>
<td>-1.6%</td>
<td>-0.6%</td>
<td>-0.6%</td>
<td>-8.7%</td>
</tr>
<tr>
<td>Total MT-\text{CO}_2 e emissions</td>
<td>318,527</td>
<td>317,558</td>
<td>313,667</td>
<td>311,345</td>
<td>284,951</td>
</tr>
<tr>
<td>Change from previous year</td>
<td>0.6%</td>
<td>-0.3%</td>
<td>-1.2%</td>
<td>-0.7%</td>
<td>-8.5%</td>
</tr>
<tr>
<td><strong>Emissions intensity indices</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Students (FTE)</td>
<td>32,111</td>
<td>32,637</td>
<td>32,467</td>
<td>33,319</td>
<td>34,437</td>
</tr>
<tr>
<td>Energy use (MMBtu/capita)</td>
<td>120.6</td>
<td>116.6</td>
<td>115.8</td>
<td>112.2</td>
<td>98.9</td>
</tr>
<tr>
<td>Emissions (MT-\text{CO}_2 e/capita)</td>
<td>7.9</td>
<td>7.7</td>
<td>7.6</td>
<td>7.4</td>
<td>6.5</td>
</tr>
<tr>
<td>Energy use (000's Btu /sq. ft.)</td>
<td>366.8</td>
<td>361.2</td>
<td>359.1</td>
<td>353.1</td>
<td>320.7</td>
</tr>
<tr>
<td>Emissions (kg-\text{CO}_2 e/total sq. ft.)</td>
<td>24.1</td>
<td>24.0</td>
<td>23.7</td>
<td>23.3</td>
<td>21.2</td>
</tr>
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</table>

Since FY 2005, there was a total decrease of 17.7 percent in per capita GHG emissions (Figure 4) and a decrease of 12.6 percent in emissions per square foot of total building space (Figure 5). Compared to the previous year, 2009 per capita emissions and emissions per square foot decreased by 12.2 and 9.0 percent, respectively. To provide a more accurate measure of emissions normalized by building area, emissions per square foot of conditioned space was computed (Figure 5). Unconditioned space accounts for 15 percent of total building space. Emissions per square foot of conditioned space followed similar trends with an 8.8 percent reduction from 2005.

![Figure 4. Per capita GHG emissions, FY 2005-2008 and CY 2009 (MT-\text{CO}_2 e per community member - students, faculty, and staff).](image-url)
GHG FOOTPRINT OF THE UNIVERSITY OF MARYLAND, COLLEGE PARK: 2009 INVENTORY UPDATE

Figure 5. Emissions intensity (kg-CO₂e per square foot), FY 2005-2008 and CY 2009.

GHG EMISSIONS BY SOURCE

GHG emissions associated with the natural gas-fired on-campus combined heat and power (CHP) plant (used for electricity, heating and cooling), steam boilers, purchased electricity, and transportation accounted for 96 percent of total emissions (Figure 6). The remaining 4 percent were produced by stationary sources (for cooking and emergency power generation), refrigerant releases, agricultural activities (e.g., animal agriculture and nitrogen fertilizer application), and solid waste management. Figures 6 and 7 show that the majority of GHGs emitted by the campus in 2009 came from natural gas combustion in the on-campus CHP plant (42 percent), purchased electricity (22 percent), and transportation (32 percent). This suggests that the largest opportunities for reducing campus GHG emissions are related to electricity use, heating, cooling, commuting, and air travel.

Figure 6. Contribution of major sources to University emissions, CY 2009.
Table 4 provides a year over year comparison of the University’s GHG emissions from FY 2008 to CY 2009.

<table>
<thead>
<tr>
<th>Source</th>
<th>FY 2008 Emissions (MT-CO$_2$e)</th>
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*Prior to 2009, the number of commuter parking permits was overestimated because of the way in which data were available. A new methodology adopted for the CY 2009 inventory better estimates the number of full time equivalent (FTE) commuters. As this change affects the transportation baseline (FY 2008), much of the commuting reduction in CY 2009 is due to this accounting change, and therefore may not reflect an actual reduction in emissions.
Power and Operations

On-Campus Stationary Sources

In 2009, combustion of natural gas in the campus CHP and boilers produced 121,958 MT-CO\textsubscript{2}e of emissions. This was 5,150 MT-CO\textsubscript{2}e less than the previous year. According to Facilities Management, the physical plant is capable of producing all the steam required for campus heating, 90 percent of electric use in winter, and about 50 percent in summer. In addition to providing steam for heating space and domestic water, the steam is used in summer to produce a portion of the chilled water required for air conditioning.

Non-CHP stationary sources of GHG emissions included fuels consumed during daily operations (e.g., cooking, emergency power generation, etc.). These sources produced about 5,275 MT-CO\textsubscript{2}e in 2009. This was 236 MT-CO\textsubscript{2}e higher than in 2008, accounting for 2 percent of total GHG emissions.

Purchased Electricity

The campus purchased electricity that was regionally produced by generating plants with a fuel mix that emitted 61,647 MT-CO\textsubscript{2}e, roughly 22 percent of total GHG emissions. The electricity fuel “mix” did include 4.51 percent renewable energy as required by Maryland law (Box 1). 2009 emissions were 9,275 MT-CO\textsubscript{2}e less than the previous year, a 13.1 percent decrease.

Box 1. State of Maryland Renewable Portfolio Standard (RPS)

To support an increase in the production of energy from renewable sources, in 2004, the State of Maryland enacted the Renewable Portfolio Standard (RPS), requiring 20 percent of Maryland’s electricity be generated from renewable sources by 2022\textsuperscript{5}. In 2009, a 4.51 percent renewable content was required under RPS which is included in the campus inventory.

Energy efficiency and conservation measures including Energy Service Company (ESCO) projects (Box 2), lighting retrofits, Tawes Satellite Central Utilities Building (SCUB), and SCUB3 renovations contributed a 4,964 MT-CO\textsubscript{2}e reduction of the total 13 percent reduction. The remaining reduction balance of 4,311 MT-CO\textsubscript{2}e may be attributed to more efficient operation of the CHP as well as milder summer temperatures.

Box 2. Energy Conservation Measures Begun in CY 2009

In April 2009, the University of Maryland signed a $20 million, 15-year Energy Performance Contract with Johnson Controls, Inc (JCI). The contract finances the installation of energy conservation measures (ECMs) in nine campus buildings: Mitchell, Lee, Main Administration, Reckord Armory, Ellicott Dining Hall, Biology/Psychology, Computer & Space Sciences, Cole Student Activities, and A.V. Williams. ECMs include lighting, HVAC system, building envelope, and building automation systems upgrades, as well as water conservation measures and steam trap replacements. Prior to installation, JCI provided audits to determine a building-specific list of projects that would guarantee the highest energy savings. The construction period will end March 31, 2011. Upfront costs financed by JCI are paid back through utility savings over the life of the contract.

From July through December 2009, ECMs installed by JCI reduced electricity consumption by 395,000 kWh, helping the University avoid 210 MT-CO\textsubscript{2}e and save $44,700. After construction is complete, there should be a 22 percent reduction in energy use over the baseline in the nine targeted buildings, translating into a 4,100 MT-CO\textsubscript{2}e annual reduction. The $1.7 million in avoided annual energy costs will be used to repay JCI for their investment.

Transportation

Campus transportation activities include Shuttle-UM, the University fleet, student commuting, faculty/staff commuting, and air travel. In 2009, transportation activities collectively emitted 90,231 MT-CO\textsubscript{2}e, or 32 percent of total emissions (Figure 6 and 7). Figure 8 shows each mode’s contribution to overall transportation emissions.

Figure 8. Transportation emissions by activity, CY 2009.
Air Travel

Air travel emissions were calculated for flights taken by University faculty and staff for business reasons, air travel by athletic teams, and air travel for some student programs including Study Abroad. The inventory did not include travel paid by individuals, for which they were reimbursed by non-University organizations and the University of Maryland College Park Foundation. In 2009, the campus community flew just over 53.8 million passenger-miles, 900,000 miles less than the previous year, which resulted in 41,775 MT-\(\text{CO}_2\)e of emissions, 686 MT-\(\text{CO}_2\)e less than the previous year. Figures 9a and 9b show trends since 2005.

![Business Air Travel GHG Emissions](image)

**Figure 9a.** Faculty and staff air travel emissions, FY 2005-2008 and CY 2009.

![Study Abroad Air Travel GHG Emissions](image)

**Figure 9b.** Student air travel emissions, FY 2005-2008 and CY 2009.

In 2009, air travel-related emissions accounted for roughly 15 percent of total GHG emissions and 46 percent of transportation GHG emissions.

Student Commuting

The University has a significant commuter population. According to the Office of Institutional Research and Planning, in fall 2009, 58 percent of undergraduate students lived off-campus. In 2009, students commuting by privately-owned vehicle were responsible for 21,571 MT-\(\text{CO}_2\)e, 8 percent of total emissions and 24 percent of transportation-related emissions. Improved student vehicle average fuel economy reduced emissions by 1,890 MT-\(\text{CO}_2\)e and a slightly
shorter average commute distance led to a 671 MT-CO\(_2\)e reductions. As noted above, an accounting change was implemented in CY 2009 to more accurately calculate the number of faculty, staff, and students who commute to campus by car.

**Box 3. Better Commuter Data Led to an Emissions Reduction in 2009**

In summer 2009, DOTS began requiring students to include vehicle make, model, and year when registering for a commuter parking permit. This data was analyzed to determine the average fuel economy of student commuter vehicles. Prior to 2009, the inventory was calculated using the national average fuel economy of 22.1 miles per gallon (mpg). Based on the students’ self reported data, the average fuel economy of Maryland commuter students was found to be significantly higher – 24.0 mpg. Use of this new data led to a 1,890 MT-CO\(_2\)e reduction in the CY 2009 inventory. Currently, this data is not collected from faculty and staff.

Table 5 illustrates a possible correlation between Shuttle-UM ridership, the number of student commuter parking permits purchased, and an estimated change in the number of beds on and near campus. While on-campus beds can be easily quantified from year to year, the number of beds that are “near” to campus is more difficult to track. For that reason, a rough estimate is made that includes large projects coming on-line in the greater College Park community.

**Table 5**. Shuttle-UM ridership, student commuter parking permit data, and estimated Student beds on and near-campus.

<table>
<thead>
<tr>
<th></th>
<th>FY 2006</th>
<th>FY 2007</th>
<th>FY 2008</th>
<th>CY 2009</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Shuttle-UM ridership</strong></td>
<td>1,660,447</td>
<td>2,030,816</td>
<td>2,340,828</td>
<td>2,627,029(^9)</td>
</tr>
<tr>
<td><strong>No. of student commuter parking permits</strong></td>
<td>13,544</td>
<td>12,123</td>
<td>11,196</td>
<td>11,265</td>
</tr>
<tr>
<td><strong>Estimated change in beds on/near campus</strong></td>
<td>1,107</td>
<td>936</td>
<td>336</td>
<td>-99(^{10})</td>
</tr>
</tbody>
</table>

Trends indicate that more students are living closer to campus and making use of Shuttle-UM in lieu of driving to campus. This is encouraging for the campus’ carbon footprint and should be tracked going forward.

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6 The table begins in 2006 given data availability.
7 Personal Communication, Beverly Malone, Assistant Director, Department of Transportation Services.
8 Source: Department of Resident Life and Off-Campus Housing Services.
9 Data is for FY 2009.
10 In 2009, the number of on-campus beds decreased and no large near-campus housing complexes came on-line. An additional 1,500 on- and near-campus beds are expected in 2010.
Faculty/Staff Commuting

Employee commuting by personally-owned vehicle emitted 20,180 MT-CO$_2$e, representing 7 percent of total emissions and 22 percent of transportation related emissions. Faculty and staff commuting emissions were 1,812 MT-CO$_2$e less than in 2008, however much of this decrease is due to a change in accounting practices.

The Climate Action Plan calls for a commuter parking permit reduction of 3,450 by 2015 (over 2008 levels). Based on the new accounting methodology for estimating the number of commuter parking permits, there were 69 fewer commuters in CY 2009, compared with FY 2008.

University Fleet

The University owns and maintains a fleet of Facilities Management (FM) vehicles, motor-pool vehicles, fire and rescue vehicles, and agricultural machinery; the vast majority burn gasoline and diesel$^{11}$. In 2009, the University Fleet emitted 4,487 MT-CO$_2$e, a 2.7 percent reduction over 2008 emissions, contributing roughly 2 percent of total GHG emissions and 5 percent of transportation-related GHG emissions.

Shuttle UM

Shuttle-UM represents an extensive network of bus routes that serve the immediate campus and nearby residential and commercial districts. It also includes three park and ride routes. In 2009, Shuttle-UM emitted 2,217 MT-CO$_2$e accounting for 0.8 percent of total emissions and 3 percent of total transportation-related emissions. Despite ridership increases (Figure 10), Shuttle-UM emissions decreased by 3.4 percent in 2009.

![Shuttle-UM Ridership](image)

**Figure 10.** Shuttle-UM ridership, FY 2005-2009.

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$^{11}$ The Campus Carbon Calculator used emission factors 0.009 MT-CO$_2$e/gallon and 0.01 MT-CO$_2$e/gallon for gasoline and diesel, respectively.
Other Greenhouse Gas Emission Sources

Refrigerants and Other Chemicals

In 2009, emissions resulting from refrigerant releases were 2,550 MT-CO$_2$e, accounting for 1 percent of total GHG emissions. As Box 4 shows, over the FY 2005 baseline, CY 2009 emissions represented a 46 percent net decrease in emissions associated with these refrigerants. FY 2009 refrigeration-related emissions were 1,455 MT-CO$_2$e less than CY 2008, representing a 36 percent reduction.

In response to EPA mandated reporting guidelines, the University tracks the usage and release of refrigerants. Refrigerants can be inadvertently released due to equipment failure. Refrigerant releases are primarily dependant on chiller (large air conditioning unit) performance. In a given year, old chillers may have fugitive emissions (inadvertent releases) of chemicals with high global warming potentials – several thousand times that of CO$_2$. In a subsequent year, if the chillers are properly decommissioned and replaced, the likelihood of a release will be significantly reduced.

Campus refrigerant releases have fluctuated widely, due in part to aging equipment. As equipment is replaced with newer systems, refrigerant related emissions should decrease.

Agriculture

Campus agricultural emissions come from methane produced by the decomposition of animal excreta, enteric fermentation, and nitrous oxides released from fertilizer application to fields and grounds. The University operates an on-campus barn that manages minor animal agricultural operations. On-campus agricultural activities also include the application of organic and synthetic fertilizer to the campus grounds, athletic fields, and golf course. The inventory also includes the College of Agriculture and Natural Resources’ eight Maryland Agricultural Experiment Station farms. Agricultural emissions were 1,944 MT-CO$_2$e in 2009, 81 MT-CO$_2$e

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12 Personal communication, John Vucci, Associate Director of HVAC Systems, Facilities Management.
less than the previous year. This was largely due to a reduction in the size of the Extension dairy herd. Overall, these emissions accounted for less than 1 percent of total emissions.

**Solid Waste Management**

The University landfilled all of its solid waste generated for disposal. In 2009, solid waste landfill practices produced 1,346 MT-CO$_2$e, 3,140 MT-CO$_2$e less than the previous year; this total accounted for less than 0.5 percent of total campus GHG emissions.

Landfilled solid waste from campus operations has decreased 34 percent since 2005, reaching 57.4 percent in 2009. GHG emissions associated with solid waste management have decreased 82 percent over the same period. In 2009, 21 percent less waste was landfilled than in 2008, with an emissions reduction of 70 percent. See Box 5 for discussion of these dramatic reductions.
As the graph above shows, there has been a gradual decrease in the amount of landfilled solid waste generated on campus. This is due to greater waste diversion (reuse and recycling, particularly of heavy items such as construction and food waste). The dramatic reductions in solid waste-related GHG emissions are due to campus waste being shipped to landfills with methane recovery and flaring and methane recovery for electricity generation. Historically, UM landfill vendors did not capture the methane that was released into the atmosphere as a byproduct of decomposition. Methane is a potent greenhouse gas with a global warming potential of 23, meaning that one metric ton of methane is equal to the emission of 23 metric tons of CO₂.

If the University had diverted 100 percent of its 2009 solid waste stream to a landfill that captures methane for electricity generation, GHG emissions would have been reduced by an additional 514 metric tons. Beyond selecting vendors who capture methane for electricity generation, the University can further reduce solid-waste emissions by adopting additional waste minimization and diversion strategies.
RECOMMENDATIONS & NEXT STEPS

Recommendations

The following should be considered for improving the accuracy and breadth of future campus GHG inventories:

- Collection of data about faculty and staff vehicles – make, model, and year – would make the faculty/staff commuting emissions calculation more accurate. This information was collected from student commuters in 2009 and resulted in a decline of overall campus emissions by 1,890 MT-CO₂e.
- Better information about commuting behavior, particularly frequency of trips to campus and use of alternative modes of transport would strengthen the inventory and provide information that could be used to improve green commuting options.
- Better capture of local addresses for students would ensure that commuting emissions are not misstated. As these data are self-reported as part of the commuter parking permit registration process, there appears to be no simple solution for improving data accuracy.
- The inventory did not include an estimate of GHG emissions associated with the consumption of materials and supplies (e.g., paper, food, bottled water). However, future versions of the Carbon Calculator may have expanded capabilities to estimate GHG emissions associated with purchasing. Future inventories should make use of improved versions of the Carbon Calculator.
- It will be important to ensure a consistent fuel mix is used to calculate purchased electricity for all University System of Maryland institutions as all 12 procure their purchased electricity through the same contract.

Next Steps

As noted above, the information in this inventory update will be used by campus stakeholders to prioritize strategies outlined in the Climate Action Plan, to track progress, and refine goals and milestones going forward. A number of campus units have already begun to implement strategies that will reduce the campus’ emissions and additional efforts will begin, under the supervision of the University Sustainability Council, which was convened in September 2009.

The Presidents’ Climate Commitment requires that participating institutions conduct GHG inventories every two years. It should be noted that future campus GHG inventories will be based on the calendar year and not the fiscal year. This change is being made to accommodate new reporting requirements by the U.S. Environmental Protection Agency and the State of Maryland, both of which require calendar year reporting. The next campus GHG inventory will cover calendar years 2010 and 2011 and will be issued in 2012.